STATEMENT OF BASIS AND PURPOSE

UNDERGROUND INJECTION CONTROL REGULATIONS

OFFICE OF DRINKING WATER
ENVIRONMENTAL PROTECTION AGENCY

June, 1979

NATIONAL UIC PROGRAM DOCKET CONTROL NUMBER D01062

STATEMENT OF BASIS AND PURPOSE

INTRODUCTION

This document is intended to summarize the basis and purpose underlying the underground injection control regulations proposed in 40 CFR Part 146 (44 F.R. 23738). It sets forth generally the reasoning behind regulatory choices in the proposal and references certain data upon which EPA relied.

This statement first discusses the categorization of wells. It then surveys the major pathways which contaminants can take to enter underground sources of drinking water and the requirements which these regulations propose to impose to assure that migration of fluids resulting from well injection does not contaminate underground sources of drinking water. Programmatic requirements of Part 146, such as monitoring and reporting, are covered in the concluding section.

In general, the requirements of this proposal differ from those of the initial proposal of these regulations (41 FR 36730, August 31, 1976) in that they furnish a greater degree of flexibility to state Directors in regulating well injection. EPA has modified its earlier proposal in this way as it became more fully aware of various well injection practices, the characteristics of substrata into which fluids are injected, and the range of methods by which well injection is accomplished

CATEGORIZATION OF WELLS

The proposed regulations separate wells into distinct categories. This categorization is necessary to assure that wells with common design and operating technique would be required to meet similar or identical performance criteria.

In categorizing wells, EPA first looked to available literature regarding the injection practices. It considered information on existing and-abandoned injection wells, practices, well construction technology, and on the variety of fluids injected into wells. It discussed with regulatory agency personnel from many states their experience with then-existing well injection regulatory practices and reviewed existing regulations in several states. After such review and discussions, it commissioned two reputable consulting organizations to provide assessments and reports on types of wells and their typical operation. EPA then studied this information to arrive at a consistent, and comprehensive well classification scheme. As a result, EPA decided to classify wells into the following five groupings:

> Class I: industrial and municipal disposal wells and nuclear storage and disposal wells that inject below all underground sources of drinking water.
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> Class II: all injection wells associated with oil and gas storage and production.

Class III: all special process injection wells, for example those involved in the solution mining of minerals, in situ gasification of oil shale, coal, etc., and recovery of geothermal energy.

Class IV: wells used by generators of hazardous wastes or hazardous waste management facilities to inject into or above underground sources of drinking water.

Class V: all other injection wells.

In formulating these classifications, EPA gave substantial weight to a number of considerations. First, the agency concluded that wells which inject into strata nearest the land surface should, as a general matter, be classified separately from those which inject into strata of greater depth. The method of injection which wells use is frequently dependent upon the injection horizon into which they deposit fluids. Wells which inject into strata near the land surface often inject by use of simple gravity. Often crudely constructed, they can simply be holes dug or bored into the ground, the sides of which may be stabilized by brick, stone, timber, or other materials in the well. They can function as convenient dumping sites for wastes, or, in other instances, can serve beneficial purposes, such as recharging groundwater supplies or creating a subsurface barrier to saltwater intrusion.[1]

Wells which inject into lower strata are usually constructed and operated differently from wells which inject into strata near the land surface. Such wells are drilled rather than dug or bored, and emplace fluids into the subsurface by use of more sophisticated technology, materials, and equipment. Wells of this sort require the use of casing and cementing. Escape of injected fluids into sources of drinking water is prevented by such casing, and by tubing and packer or other methods. Injection is accomplished by either the force of gravity or the application of additional mechanical pressure to overcome the natural friction and hydrostatic resistance of the receiving formation.[2]

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[1] See Generally The Report to Congress, Waste Disposal Practices and Their Effect of Groundwater, U.S. Environmental Protection Agency (January, 1977), Sections V, VIII, Xiii ("Report to Congress"); A Manual of Laws, Regulations, and Institutions for Control of Groundwater Pollution, Final Report, U.S. Environmental Protection Agency, (June, 1976), Chapter IG ("Manual"); Underground Injection Control Regulations Subpart F Injection Well Practices, Draft Final Report, Geraghty and Miller, Inc. and Temple Barker and Sloane, Inc., (March, 1978) ("Subpart F"); Preliminary Evaluation of Well Injection Practices, Geraghty and Miller, Inc. ("Preliminary Evaluation").

[2] See Generally Report to Congress Section XI, XHI; Manual, Chapter IC; Preliminary Evaluation; Ground Water Pollution From Subsurface Excavations, U.S. Environmental Protection Agency, 1973, Part 2, Section II. ("Ground water Pollution").

In addition, aquifers nearest the land surface most often supply water for domestic use.[3] Consequently, wells which inject into or above these aquifers increase the risk of human exposure to the injected contaminants.

These considerations influenced the categorization of wells in Classes I and II separately from those in Classes IV and V. Classes I and II encompass wells which normally-inject into strata below underground sources of drinking water; Class IV wells (which by definition inject into or above strata containing underground sources of drinking water) will generally inject into or above the aquifers nearest the land surface. Class V for the most part comprises wells which inject non-hazardous materials into those same aquifers.[4]

Also influencing this proposed well classification was the nature of injected fluids. Wells which handle hazardous materials warrant close regulatory scrutiny. This consideration in part influenced EPA to create a separate category (Class I) for wells which dispose of industrial, municipal, and nuclear wastes. Such wastes commonly contain chemicals or other substances which can be fairly characterized as noxious or hazardous. For this reason, Class I wells warranted separate classification and, as appropriate, separate performance criteria.

Similarly, among those wells which inject into aquifers nearest the land surface, Class IV wells were separated from Class V because of the heightened risk which Class IV wells create. Class IV wells may be the most harmful class of wells because of the hazardous nature of fluids injected into them and the proximity of their injection zone.to underground sources of drinking water.

An additional factor which influenced this reproposed classification of wells was the Safe Drinking Water Act (IISDWAII) itself. Sections 1421(b)(2) and 1422(c) of the SDWA state that regulations for State underground injection control programs may not prescribe a requirement which interferes with or impedes underground injection in connection with oil and natural gas production or the secondary or tertiary recovery of oil and natural gas unless such a requirement is essential to assure that underground sources of drinking water will not be endangered by such injection. House Report No. 931185 accompanying the Act takes care to clarify this directive. At page 31, the Report characterizes the term "interferes with or impedes" as referring to only those requirements which would "stop or substantially delay" oil or natural gas production. Thus, the "test" of essentiality would only be relevant upon a demonstration that a requirement would stop or substantially delay such production.

EPA has observed this statutory admonition by including all injection wells relating to oil and gas production and hydrocarbon storage into a single category (Class II). Such a grouping makes it possible to modify specific. requirements and allow additional flexibility where possible

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3 Report to Congress, Sections VIII, IX, XIII; Manual, Chapter IC; Subpart F; Preliminary Evaluation.

4 Report to Congress, Sections VIII, IX, XIII; Manual, Chapter IC; Subpart F; Preliminary Evaluation.

without sacrificing environmental protection.

Class III, which includes special process wells (including those used for solution mining) are classified separately from other wells because of their atypical injection practices. Special process wells serve a variety of purposes, including the extraction of minerals or other materials from the earth.

Finally, Class V wells, which include all wells not covered by the preceding categories, primarily comprise wells which inject non-hazardous materials. EPA currently lacks comprehensive information on these remaining injection practices, but the Agency has reason to believe that they pose a significantly lesser environmental danger than do other categories of wells. Some Class V wells can cause risks to public health, of course, but many of them can be actually beneficial to groundwater. Due to incomplete data, EPA has classified these remaining wells together and is proposing no immediate performance criteria for them at this time. Instead, these wells are to be assessed and, based on that assessment, EPA will formulate a regulatory program suitable for them at a later time.

PERFORMANCE CRITERIA

The regulations propose the use of a variety of measures to assure that injection wells will not jeopardize underground sources of drinking water. This section addresses the major technical requirements by discussing each in conjunction with the particular problem it is designed to prevent or remedy. The "problems" are basically six in number, and are described here as "pathways of contamination" - Ways in which fluids can escape the well or injection horizon and enter underground sources of drinking water. These "pathways" are the following:

1. migration of fluids through a faulty injection well casing;

2. migration of fluids upward through the annulus located between the casing and well bore;

3. migration of fluids from an injection zone through the confining strata;

4. vertical migration of fluids through improperly abandoned and improperly completed wells;

5. lateral migration of fluids from within an injection zone into a protected portion of that stratum; and

6. direct injection of fluids into or above an underground source of drinking water.

PATHWAY I - MIGRATION OF FLUIDS THROUGH A FAULTY INJECTION WELL CASING

______The casing of a well can serve a variety of purposes. It supports the well bore to prevent collapse of the hole and consequent loss of the well, serves as the conductor of injected fluids from the land surface to the intended injection zone, and supports other components of the well. If a well casing is defective, injected fluids may leak through it. Such migration can contaminate an underground source of drinking water.[5]

To prevent migration of fluids in this manner, the reproposed regulations require that wells in Classes I through III use casing “sufficient to prevent the migration of fluids into any underground source of drinking water.”[6] The impact of this standard should vary on a well-by-well basis. In some instances, injection wells would only need a minimal surface casing to prevent migration of fluids into underground sources of drinking water. In other cases, multiple strings of casing might be necessary. EPA is proposing this flexible, goal-related standard, rather than a fixed requirement, in order to allow state Directors - the discretion to vary the requirement, as appropriate, in each instance. Allowing this discretion should lessen the cost of the requirement while still accomplishing its preventive objective.[7]

The regulations also require wells to comply with certain operational requirements. Foremost among these is the requirement to demonstrate mechanical integrity.[8] A mechanical integrity test is used to verify, as its name indicates, the "integrity" of a well, i.e., whether it is sound and does not leak. The regulations would require operators of all new wells (wells coming into operation after an applicable UIC program becomes effective in the state) to conduct mechanical integrity tests and provide the results to the Director. If a test indicated that a well did not have mechanical integrity, i.e., it leaked injected fluids, the well would not be authorized for injection. For existing wells, the regulations require that mechanical integrity be demonstrated before continued operation of the well can be authorized.

The selection of a mechanical integrity test as a requirement of these regulations is uniquely appropriate because normally wells cannot be inspected directly. The Agency has determined that mechanical integrity tests are the most reliable ways by which the soundness of wells can be demonstrated. The regulations cite a variety of mechanical integrity tests which may

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[5] Report to Congress, Sections XI, XIII; An Introduction to the Technology of Subsurface Wastewater Injection, U.S. Environmental Protection Agency (December, 1977), Chapter 7 ("Subsurface Wastewater Injection").

[6] §§146.12(b); 146.22(b); 146.32(a). For a full discussion of the requirements for Class II wells, see pages 11-12 below.

[7] Subsurface Wastewater Injection, Chapter 7.

[8] §§146.15 (t); 146,25(p); 146.35(t)

be used.[9] These tests are commonplace in the well injection industry, and are considered reliable indicators of mechanical integrity.[10]

The regulations also would allow the use of mechanical integrity tests not specifically listed in the text.[11] To use any of these tests, a Director would have to demonstrate its suitability for the intended purpose and secure EPA approval prior to its use. Once approved by EPA, the test would be eligible for use by all persons unless specifically restricted. EPA allows this flexibility because it recognizes that there may be mechanical integrity tests which, although unspecified in the regulations, are fully adequate to detect well defects. Moreover, tests which might be acceptable may be developed in the future.

The regulations further require that operators of wells which have been authorized for injection under this program shall perform additional mechanical integrity testing at least once every five years of operation.[12] The agency decided on the five year frequency period after long consideration and consultation with state officials. EPA staff determined that the requirement for a mechanical integrity test at least every five years during operation of the well would provide satisfactory assurance of continued well soundness and would be reasonable from a cost perspective. Moreover, the five-year review schedule facilitates Agency efforts to combine the several permit programs under its charge.

A second protective feature of these regulations is the requirement for tubing and packer. Tubing and packer can best be described as a removable liner device within a well which isolates the casing of the well from injected fluids. By preventing this contact between casing and injected fluids, the possibility of migration of contaminants through leaks in the casing is greatly diminished. For the same reason, tubing and packer also lessens the chances of corrosion of the casing. Tubing and packer offers two further advantages. It isolates the annulus (between the tubing and casing) from the injection zone, facilitating detection of any leaks in the tubing. It also allows for visual inspection for deterioration of the tubing during routine maintenance.[13]

The regulations make the use of tubing and packer or an acceptable substitute mandatory for Class I wells,[14] except for municipal wells injecting only non-corrosive fluids. EPA expects that Class I wells will be injecting highly corrosive material more frequently than others; hence,[15]

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9 §146.08(b).

10 Subsurface Wastewater Injection Chapter 7.

11 §146.08(d).

12 §§146.14(b)(3); 146.24(b)(3); 146.34(b)(3)

13 Subsurface Wastewater Injection Chapter 7.

14 §146.12(c).

15 Report to Congress, Section XIII: Ground Water Pollution, Part 9, Section II.

routine use of tubing and packer or an acceptable substitute becomes appropriate (For Class II and III wells, the requirement to use tubing and packer is discretionary with the Director because the inflexible use of the requirement for Class II and III wells would likely interfere with production from many of these wells without any significant environmental gain.[16] 'Rven though a tubing and packer requirement is not mandatory for wells in Classes 11 anti M, T)irectors should require its use when appropriate to prevent fluid migration into underground sources of drinking water).

When the use of tubing and packer in Class I Wells is inappropriate, the reproposed regulations allow for use of alternative means to accomplish the same objective[17]. In f act, based upon the type of well involved, it is possible that an alternative to tubing and packer might actually provide a greater degree of protection. 'For example, in some instances, tubing with a fluid seal will produce the same or better results as would tubing with a packer.[18] When this or other effective methods are proposed, EPA does not oppose their use. Prior to use, however, EPA reserves the right of review and approval.

The final provision by which the regulations propose to eliminate contamination through this first pathway is to require that Class I and III wells which inject corrosive fluids be constructed of corrosion-resistant materials.[19] This standard is intended to prolong the operating life and continued viability of wells.

PATHWAY 2 – MIGRATION OF FLUIDS UPWARD THROUGH THE ANNULUS LOCATED BETWEEN THE CASING AND THE WELL BORE

A second way by which contaminants can reach underground sources of drinking water is by migrating upward through the annulus located between the drilled hole and. the casing. Under usual injection conditions, injected fluids, upon leaving the well in the injection zone, enter a stratum which to some degree resists the entry of the fluids. Resistance results from friction created by extremely small openings in the materials which comprise the injection zone. Because fluids tend to take the path of least resistance, unless properly contained, they may travel upward through this annulus. If sufficient injection pressure exists, the fluids could migrate into an overlying source of drinking water.

The measures taken in the regulations to prevent contamination by this Pathway are parallel to those already mentioned concerning Pathway 1. In this case, well injectors must demonstrate to the satisfaction of the Director that there is no significant fluid movement into

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16 Subsurface Wastewater Injection, Chapter 7.

17 §146.12(c).

18 Subsurface Wastewater Injection, Chapter 7; See also Cook, T.D. Underground Waste Management and Environmental Implications. American Association of Petroleum Geologists (Tulsa, Okla., 1972).

19 §146.12(d).

underground sources of drinking water through this annulus.[20] Mechanical integrity tests can be conducted to provide information on contamination by this route.[21] As with Pathway 1, and for the same reasons, mechanical integrity must be demonstrated at least every five years.

For Class I and III wells, the annulus between the hole and casing must also be filled with cement adequate to prevent the flow of fluids into an overlying drinking water source.[22] Depending upon the complexity of the well, this cementing can be accomplished in different ways. A well with a single casing, for example, may need cementing at only one interval (e.g., through the confining stratum which separates the injection zone from the source of drinking water). Other wells, which penetrate to greater depths or which involve more than one casing, may need a more elaborate cementing procedure. Because of th is range, EPA is proposing the cementing requirement in general terms and intends to leave decision making to the Directors' discretion. Directors are instructed in the regulations to take a variety of factors into account when determining specific cementing requirements for individual wells.[23]

The casing and cementing requirement for Class II wells is different from that of Classes I and III. The Director need not require additional casing and cementing for Class II injection wells located in existing injection fields if: (1) the state in which the well is located has had applicable regulatory controls in effect prior to the introduction of the federal program; (2) the Director imposes those pre-existing controls; and (3) well injection under these circumstances will not create any significant risk to the health of persons using the water for drinking purposes.[24]

Various considerations underlie this modified approach. As mentioned in the preamble to these regulations, costs played a role: EPA data indicates that compliance with the above-discussed casing and cementing requirements could generate costs to the oil industry of more than $20 billion over 5 years.[25] Imposing regulatory requirements of this financial magnitude would interfere with injection of brines or other fluids which are brought to the surface in connection with oil and gas production and with injection for secondary or tertiary recovery of oil or gas. Moreover, the imposition of this casing and cementing requirement could be an unnecessary disruption of state UIC programs currently in effect and being enforced in a substantial number of states.

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[20] §§146.12(t); 146.25(p); 146.35(t).

[21] §146.08(c).

[22] §§146.12(b); 146.22(b); 146.32(a).

[23] §§146.12(b)(1)-(c); 146.22(b)(1)-(6); 146.32(a).

[24] §146.12(b).

[25] Estimated after discussions with consultants. See generally <u>Cost of Compliance, Proposed Underground Injection Control Programs, Oil and Gas Wells.</u> Arthur D. Little, Inc.(June, 1979) ("Oil and Gas Wells").

More importantly, the imposition of the"full" casing and cementing requirement on Class II wells in existing injection fields would not yield significant environmental benefit. If past injection was performed in an unsafe way, nearby water resources will likely be too contaminated for consumption as drinking water. Imposing casing and cementing in this instance would not be helpful to the environment. On the other hand, if the injection has been performed historically in a way which is protective of underground drinking water, it is reasonable to believe that the injection method will continue to protect underground sources of drinking water. These facts are particularly applicable to Class Il wells because they are relatively older than wells in other categories[26] and are normally found in groups the members of which are similarly constructed.[27] Older wells, with longer histories of operation, are more likely to have contaminated drinking water, if at all, by this time, than are newer wells. Moreover, the similar construction of wells in specific fields increases the chances that, if contamination has occurred, it is already extensive.

Lastly, the need for the "full" casing and cementing of Class II wells is generally less because brine and other fluids associated with oil and gas production are less hazardous than fluids which Class I and III wells often inject.

PATHWAY 3 - MIGRATION OF FLUIDS FROM AN INJECTION ZONE THROUGH THE CONFINING -STRATA

The third way by which fluids can enter an underground source of drinking water is from an injection zone through the confining strata. Upon entrv into an injection zone, fluids injected under pressure will normally travel away from the well laterally and through the receiving formation. In most cases, this expected occurrence gives rise to no concern, but, if the confining stratum which separates the injection zone from an overlying or underlying underground source of drinking water is either fractured or permeable, the fluids can migrate out of the receiving formation and into the protected region.

For obvious reasons, there are no well construction standards which can address this problem of migration of fluids through this pathway. Consequently, the regulations propose two provisions to assure that fluids do not travel this pathway into underground drinking water. First, the regulations require that, prior to the issuance of a permit, the geologic characteristics of the injection zone and confining strata be reviewed.[28] Data already available to states can assist Directors in making these reviews. A permit should only be issued upon the Director's finding that the underground formations are sufficiently sound to contain fluids in the injection zone.

Second, the regulations require that well injection pressure be controlled to prevent opening fractures in the confining strata or otherwise causing the rise of fluids into an overlying

26 Report to Congress, Section XI.

27 Id..

28 §§146.15(e); 146.25(e); 146.35(d)(e).

protected zone.[29] Using this mechanism, injection pressures can he restricted to provide conservative protection even in the face of less than ideal geologic characteristics. For example, if a confining stratum is known to be fractured or permeable, injection might still be permissible if done at predetermined pressure levels which under no circumstances could cause a rise of fluids to the height at which it would enter a drinking water source.

PATHWAY 4 - VERTICAL MIGRAFTI0N OF FLUIDS THOUGH IMPROPERLY ABANDONED AND IMPROPERLY COMPLETED WELLS

One of the common ways by which fluids can enter an underground source of drinking water is by migration through improperly abandoned and improperly completed wells. This would occur if fluids moving laterally within an injection zone encountered an improperly abandoned or completed well, and, following the path of least resistance, flowed upward within the well until entering an overlying underground source of drinking water or overflowing onto the land surf ace. Because of the large number of wells drilled in the past, and because well operation and abandonment have not always benefitted from close regulatory scrutiny, contamination by this route can represent a significant risk to public health. It is estimated that there are about 17,000 improperly abandoned or improperly completed wells which could cause this problem.[30]

To prevent this contamination, the regulations require Directors to determine an "area of review" for injection wells. This is the area around the injection well through which the incremental pressure of injection can cause vertical migration. Operators of Class I, III, and new Class II wells (operators of existing Class II wells are treated differently; see below) must locate other wells within the "area of review" and correct any problems related to improperly abandoned or improperly completed wells before beginning injection.[31] Under this approach, well injectors would have the affirmative responsibility to demonstrate that the proposed injection operation would not cause contamination by this route.

Directors could choose either of two methods to determine the area of review. The first method would be to require use of a mathematical formula to determine, on a case by case basis, the lateral impact which an injection operation could cause. The formula would indicate the distance outward from the well which this particular injection would or could affect. The regulations provide a formula which can he used for this purpose. It takes into account a range of factors, including hydraulic conductivity, thickness of the injection zone, time of injection, storage coefficient, injection rate, hydrostatic head and specific gravity. EPA is proposing this particular formula because it is based on an equation which has been in common use for years and, in that time has demonstrated satisfactory results.[32]

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[29] §§146.14(a)(1); 146.24(a(1); 146.34(a)(1).

[30] Oil and Gas Wells, Chapter VIII-D.

[31] §§146.06; 146.07.

[32] §146.06(c).

If the formula indicated that no problem exists, iniection could commence without any obligation to repair faulty wells found within the area of review. If it did indicate a problem, however, the well operator would be expected to correct it. In the worst case, correcting the problem could mean that the well operator would have to plug a faulty well at his/her expense. In other cases, the operator might simply have to modifV injection -pressure to assure that the rise of fluids caused by the would not cause fluids to enter an underground source of drinking water.

The use of a formula to determine the area of review may not alwavs be feasible. In some instances, necessary information to may be lacking. quch formulas also do not have universal applicability: mathematical formulas, because they are based on ideal conditions (that aquifers are homogeneous, isotropic, and infinite in extent, for example), may not always reflect actual subsurface conditions. Moreover, they assume radial flow in all directions and, in some cases, will not yield a finite distance measurement for well review purposes.

Because of these possibilities, the regulations offer a second method for determining the area of review. Directors may use (in lieu of a case by case formula) a fixed radius of one-quarter mile or greater. The Agency selected this minimum radius after consideration of current state practices. EPA had considered use of more extensive review requirements, particularly the use of a one-half mile radius for area of review computation, but decided against them because the less rigorous requirement is more cost-effective. In many cases, use of a larger fixed radius would result in duplicative review of the same wells.[33]

Moreover, the quarter-mile radius is compatible with coverage practiced in most states. Generally, states impose review requirements on well operators in a range of 1000 feet from the injection site up to two miles. EPA's selection of the quarter-mile distance represents its assessment of the effectiveness of these varying requirements in the state programs.

EPA has modified the area of review requirement for Class II wells.[34] Unlike the proposal for wells in Classes I and III, the regulations only require that new Class II wells, observe area of review and corrective action requirements. Class II is characterized by large numbers of wells clustered in oil fields. Because new injection wells are interspersed with existing Class II wells, imposing the area of review anti corrective action requirements on new Class II wells should still result in discovery and correction of all faulty wells within the existing well fields, although over a more extended time frame.[35] The Agency opted for this approach because it deemed it to be effective, both from an environmental and cost perspective, and because it considers placing expenses on new, rather than existing, well operators to he a preferable regulatory approach.[36]

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[33] See generally Oil and Gas Wells, Chapter VIII

[34] §146.21(e).

[35] See generally Oil and Gas Wells, Chapter VIII.

[36] Id..

With respect to corrective action itself, the regulations impose a flexible standard. EPA is proposing that the corrective action required for each well be fashioned by the Director on a case by case basis.[37] EPA prefers this approach because of the variety of problems or conditions which can trigger the need for corrective action. In one instance, the only corrective action which may be needed to prevent the migration of fluids into an underground source of drinking water through a faulty well might be a reduction of the pressure at which fluids are injected. In other instances, monitoring of nearby wells coupled with a contingency plan to remedy any problems which result from the injection operation might be feasible. In still other cases, it might be necessary to correct the wells. This range of possibilities, as well as the significant costs which corrective action can generate, have encouraged the Agency to adopt the more flexible approach.

PATHWAY 5 - LATERAL MIGRATION OF FLUIDS FROM WITHIN AN INJECTION ZONE INTO A PROTECTED PORTION OF THAT STRATUM

In most cases, the injection zone of a particular well will be obviously segregated from underground sources of drinking water by impermeable materials. In some instances, however, well injectors may inject into an unprotected portion of an aquifer which in another area will be designated for drinking water purposes. In this event, there may be no impermeable laver or other barrier to prevent migration of fluids into underground drinking water.

Injection into unprotected portions of aquifers which contain drinking water in other areas must be done with great care. The regulations propose to control this potentially dangerous activity by according the Director a range of construction and operating controls which can be imposed at his/her discretion.[38] Usually, Directors can allow injections of this type if the predominant flow of the aquifer is such that injected fluids will tend to move away from, rather than toward, the protected part of the aquifer. Even if that is not the case, however, Directors could still allow the injection if any of a variety of operational conditions were satisfied. For example, the Director might allow an injection upon a determination that the rate of flow or the volume or pressure of injection was sufficiently small to assure that fluids would not enter the protected region.

PATHWAY 6 - DIRECT INJECTION OF FLUIDS INTO OR ABOVE AN UNDERGROUND SOURCE OF DRINKING WATER

The last pathway of contamination of groundwater is potentially the most worrisome. The injection of fluids into or above underground sources of drinking water can present the most immediate risk to public health because it can directly degrade ground water especially if the injected fluids do not benefit from any natural attenuation from contact with soil, as they might during movement through an aquifer or separating stratum.

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[37] §§146.07; 146.11(d); 146.21(f); 146.31(d); 146.14(o), 146.25(n), 1461.35(p).

[38] §§146.12; 146.22; 146.32.

The regulations prohibit direct injection of contaminants into an underground source of drinking water for wells in Classes I to III; Class IV wells, which bv definition inject in this way, are to be banned as soon as possible but in no event later than three years after the establishment of an applicable underground injection control program within a state.[39] Class V wells, of which little is known, will-he assessed before regulations for their operation are proposed[40] (for a fuller discussion of the regulatory approach proposed for Class IV and V wells, see the preamble to the regulations).

OTHER REQUIREMENTS

ABANDONMENT - the regulations also require that well injectors abandon their injection wells in a way which will prevent the contamination of underground sources of drinking water.[41] As indicated earlier, abandoned wells can act as conduits for contaminants to enter protected aquifers. To assure that currently used and future wells do not create problems of this type, the regulations require plugging of wells after termination of operation. Again, the exact means of accomplishing an effective abandonment are left to the judgment of the Director to be exercised on a case by case basis.

With respect to Class IV wells, traditional methods of abandonment, such as plugging, may be inappropriate due to the crude construction of the well. In such a case, the only abandonment requirements might simply be closure of the well.

MONITORING FREQUENCIES

The regulations also require various kinds of monitoring.[42] Monitoring can provide an early warning of potential serious degradation of underground sources of drinking water.

Wells in Classes I, II, and III share some common monitoring requirements. Injection fluids must be tested with sufficient frequency to yield data representative of fluid characteristics. Information of this sort is essential for the Director to understand the operation of a particular well. Such information serves the important function of providing basic knowledge to analyze reasons for well failures, to establish appropriate remedies to correct them and to assess any endangerment the failures might cause.

The regulations also require monitoring of operating characteristics of wells in Classes I, II, and III. Class I and III wells must have continuous recording devices to monitor injection

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[39] §146.43(a).

[40] §146.52(b)(1).

[41] §§146.13; 146.24; 146.34.

[42] §§146.14; 146.24; 146.34:146.44.

pressure, flow rate, and volume of injection fluids.[43] Continuous monitoring is appropriate because fluids injected by Class I and III wells are usually more corrosive and hazardous than are fluids injected by others. These fluid properties increase the risk of serious well leaks or failures. Continuous monitoring, furthermore, is a common practice for these wells, in part because they often inject fluids in uninterrupted streams.

Class I wells must comply with the additional requirement of continuously monitoring the pressure in the annulus of the well between the tubing and the long string. The "long string" is the casing which extends from the ground surface to the injection zone. Wells in Class III, due to operating procedures which may require the use of the annulus for injection, need not meet this requirement.

Class II injection well monitoring provisions are less stringent than those for Classes I and III.[44] Continuous monitoring is not required for Class II; rather, depending on the actual injection operation, monitoring frequency varies from daily to monthly. A stricter approach is not essential for Class II wells because of the lesser toxicity and corrosivity of fluids which Class II wells handle and because the total cost of imposing continuous monitoring on Class II wells would have been inordinately burdensome.[45]

Class III wells are also required to monitor, on a quarterly basis, water supply wells adjacent to the injection site to detect any excursions from the injection site. This monitoring is commonly practiced by operators of Class III wells.[46] EPA is proposing this requirement for Class III wells (and not for Class I wells) because Class III wells are often designed to inject into shallower strata, thereby increasing the possibility of contamination of aquifers nearest the land surface.

This added risk has prompted the Agency to require monitoring wells at each project site, located to maximize the probability of detecting any horizontal or vertical fluid excursion from the injection zone. Weekly monitoring of the fluid levels in these monitoring wells and of parameters appropriate to determine if any excursions of injected fluids are entering underground sources of drinking water is also required. This requirement, although involving additional expense, was considered necessary to assure that any migration of these potentially harmful injected fluids into underground sources of drinking water, which are often located quite close to the injection zones, would be discovered and rectified promptly.

Class IV wells also must comply with monitoring requirements. Monitoring of these wells is necessary because they inject hazardous materials into or above underground

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43 §§146.14; 146.34(b)(2).

44 §146.24(b).

45 Oil and Gas Wells, Chapter V-B, C.

46 Comments of Freeport Sulfur Co., Jan. 14, 1977; Statement by Texas Gulf Co., Oct. 13, 1976.

sources of drinking water. Operators of these wells must monitor existing water supply wells in the area weekly for contaminants which the Class IV well injects. Although more stringent monitoring requirements for this category would not be inappropriate, EPA selected this requirement because Class IV wells are scheduled for closure within three years of the effective date of a uic program in the particular state. The purpose for monitoring these wells, therefore, is solely to ascertain which, if any, of them is causing a significant risk to underground drinking water. If a well is creating a danger, the Director can order the earlier closure of it. EPA believes this monitoring provision adequately accomplishes this purpose.

No monitoring requirements are proposed for Class V wells. These wells will be assessed under the proposed regulatory scheme. The assessment should produce a substantial amount of data upon which an entire regulatory approach, including monitoring, can be based.

REPORTING

The regulations also impose reporting requirements on well injectors.[47] Owners and operators of wells regulated under Classes I and III must report the results of monitoring and any other significant operational information at least quarterly, while Class II well owners and operators need only report to the Director annually. The reasons underlying these proposals parallel those for the monitoring requirements. Operators of wells which inject fluids of greater potential hazard must report more often than those which do not. Class IV wells are treated separately because thev will be phased out within three years. Class V wells need not submit monitoring or reporting data because the assessment planned for this category will supply EPA with a substantial amount of data in its own right.

[47] §§146.14; 146.24; 146.34; 146.44.